Montana Department of Transportation	Date Issued: **November 1st, 2024**
	Date Effective: **November 1st, 2024**
CONSTRUCTION MEMO **DESIGN MEMO**	Related Specifications: **§§ 401, 402, 702**
Subject: **Guidance for Final Implementation of Multiple Stress Creep & Recovery (MSCR) PG Binder Specification**	

To: Distribution

From: Ross "Oak" Metcalfe, P.E.,
Materials Engineer

Damian Krings, P.E.,
Highways Engineer

MC
Revised 11/21/2024

The purpose of this memo is to provide implementation guidance to both Construction and Design staff on finalizing the switch to the Multiple Stress Creep & Recovery Performance Grading system for Asphalt Binder, commonly referred to as "massacre" due to its acronym, "MSCR". This memo supersedes all other guidance on MSCR.

For a more comprehensive discussion of the history and technical aspects of the Multiple Stress Creep and Recovery test and specification development, Tech Brief WRSC-TB-20-01 from the Western Regional Superpave Center at the University of Nevada – Reno is linked below as is a PowerPoint presentation from Flint Hills Resources as presented at the 2017 North Dakota Asphalt Conference.
(https://scholarwolf.unr.edu/bitstreams/d6705de0-1975-4a17-8867-7108c875e643/download)
(https://www.ndltap.org/events/asphalt/downloads/2017_17_MSCR.pdf)

As previously indicated, the move to MSCR Binder Grading more appropriately considers temperature, traffic, and polymer modification when specifying asphalt binder.

These changes are intended to take effect in conjunction with the new Specification version as of the January 9th, 2025 letting.

Design Guidance

There is still work to be done to update the Surfacing Design guide relevant to these changes, however projects where MSCR PG 58**V**-34 asphalt binder replaced PG 64-28 binder have been successful over the past two paving seasons. That fact in conjunction with standard practice in other northern tier and rocky mountain states (North & South Dakota, Minnesota, and Wisconsin) is the basis for finalizing this change. MSCR PG

58**V**-34 has been successfully used to pave Interstates and other high traffic routes in our neighboring states, with them relying on MSCR PG 58**H**-34 for where we have been specifying MSCR PG 58**V**-34 for the past two seasons (2023 and 2024). We knew that using MSCR PG 58**V**-34 as we have been might have been overkill, but we wanted to be sure it would perform as expected.

Therefore, moving forward, MSCR PG 58**V**-34 will now be the standard top tier binder used on Interstates and areas with heavy traffic and/or slow turning movements, etc. It will now replace PG 70-28. Additionally, wherever PG 64-28 was specified previous to the changes in 2023, MDT will now specify MSCR PG 58**H**-34. Should the need arise for an unmodified binder on a bike path or some other non-critical surface, we can specify PG 58-28. There is also the option of MSCR PG 58**S**-34, but that binder may still be modified, depending on the feed stock and not give the "unmodified" cost savings.

Test results and performance of MSCR PG 58**V**-34 over the past two seasons indicate that it will give us the performance needed for higher traffic levels and is not necessary for mid-range and lower traffic levels. This should also have the added benefit of reducing costs.

For a more complete explanation of the nomenclature used by the new grading system see the references linked above, but a summary is as follows:

- "S" = **S**tandard traffic load (< 3 M ESALs)
- "H" = **H**eavy traffic load (≥ 3 M ESALs < 10 M ESALs)
- "V" = **V**ery heavy traffic load (≥ 10 M ESALs < 30 M ESALs)
- "E" = **E**xtra heavy traffic load (≥ 30 M ESALs)

With MSCR, the old concept of "grade bumping" is replaced by specifying the actual environmental temperature along with a traffic load.

As with the initial roll out, Design Project Managers should not see any significant changes. The basis of plan quantity will not change for estimating purposes and appropriate bid items have been created in AASHTOWare. Designers need only make the summary frame title changes as appropriate, replacing PG 64-28 with ~~MSCR~~ PG 58**H**-34 and replacing PG 70-28 with ~~MSCR~~ PG 58**V**-34. If there are projects that have been around long enough that PG 64-28 has already been replaced with MSCR PG 58**V**-34, those projects should be updated to specify ~~MSCR~~ PG 58**H**-34.

The existing MSCR special provision is no longer necessary as the Standard Specifications have been updated appropriately and Contractors and Refineries have had two full seasons to get comfortable with the new binders.

Construction Guidance

As indicated above, the MSCR Special Provision will no longer be necessary, and the Standard Specifications should be followed as usual for contract administration, sampling, testing, and acceptance purposes on new projects.

Attention should be paid to the updated Hamburg acceptance criteria. The Standard Specifications have been updated to once again vary the maximum number of passes allowed before the rut depth reaches ½ inch (13mm). For the time being, the test temperature will stay at 44°C for all "58" binders as we are still doing comparison testing between 44°C and 50°C.

For projects that are already awarded, Construction staff are directed as follows:

- Allow Contractors to proceed or continue with 58**V**-34.
- Should the Contractor want to use 58**H**-34 where 58**V**-34 was specified in lieu of PG 64-28, this is acceptable and encouraged, but a change order must be agreed to so MDT can recoup the cost over the higher grade of binder.
- Contact Surfacing Design if there is any question about the appropriate grade of binder.

Should any project result in a change order, the final binder price will be based on invoice price differences with the Contractor returning any decreases.

In both situations, new projects and existing projects, asphalt binder will be evaluated and accepted in accordance with section 402.

Background

(This information was distributed in the previous memo on this subject but is presented here again for informational purposes.)

MDT has been specifying performance graded asphalt binder for the past two decades according to AASHTO M 320 "Standard Specification for Performance-Graded Asphalt Binder". AASHTO M 320 was an advancement over previous asphalt binder specifications, however we have since learned that it doesn't accurately capture the performance of modified binders or the specific effects of polymer or other modifiers.

For the past ten years, MDT has been doing comparison testing of binder to "benchmark" our existing binders. MDT still evaluates binders for contract acceptance according to M 320, however, MDT has also been evaluating binder utilizing the new grading system to develop a database of information on how our binders are performing using the new binder grading system according to AASHTO M 332 "Standard Specification for Performance-Graded Asphalt Binder Using Multiple Stress Creep and Recovery (MSCR) Test" and the new test method, AASHTO T 350 "Standard Method of Test for Multiple Stress Creep Recovery (MSCR) Test of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)".

MDT made the decision to switch based on the comparison test data (benchmarking) indicating our current binders are already meeting the MSCR specification in many ways and the new system more accurately represents conditions a binder will see in service.

Separately, but in addition to the switch to MSCR grading, MDT is also beginning to use "58-XX" binder grades, i.e., binders that have a high temperature rating of 58 °C; and "XX-34" binder grades, i.e., binders that have a low temperature rating of -34 °C.

Climatic data from FHWA's "Long Term Pavement Preservation Binder online" program (LTPPBind Online), clearly shows that Montana is predominantly a "58-34 state". There are only a few weather stations out of several hundred that rate at -28 °C with several more rating at -40 °C. Additionally, the same climate data clearly shows Montana as "58" state, again with only a few weather stations rating at 64°C and fewer at 70 °C. Our actual temperatures combined with a documented increase in thermal related cracking in our Pavement Management system led to this change. Our neighboring states are already using PG 58-34 and MSCR PG 58X-34 grades of binder. MDT used PG 64-34 in the early 2000's but stopped for various reasons that are no longer relevant after an additional two decades of asphalt binder innovation and development. Additional information on high and low temperature performance of asphalt binders is also available in the attached WRSC Tech Brief mentioned above.

Finally, MDT provided this information along with a more technical explanation of the changes to the Montana Contractors Association at the MCA-MDT Technical Committee Meeting on February 15th, 2023. If anyone is interested in this presentation or more information, please contact the Materials Bureau.

copies:

Dustin Rouse, P.E., MDT Chief Engineer
Ryan Dahlke, P.E., MDT Preconstruction Engineer
Megan Cail, P.E., MDT Highways Design Engineer
Jeremy Terry, P.E., MDT Road Design Engineer
Dave Gates, P.E., MDT Construction Engineer
Darin Reynolds, P.E., MDT ECC Bureau Chief
Shane Pegram, P.E., MDT CES Bureau Chief
Fred Beal, P.E., MDT Construction Review Section Supervisor
Joe Green, P.E., MDT Constructability and Specifications Supervisor
Mike Dodge, MDT Materials Reviewer
Jim Davies, P.E., MDT Materials Bureau Chief
Randy Boysen, P.E., MDT Materials Engineer (Incoming)
Matt Needham, MDT Testing Operations Supervisor
Jon Cloonan, MDT Chief Chemist
Jeff Jackson, P.E., MDT Geotech and Pavements Engineer
DJ Berg, P.E., MDT Pavement Analysis Engineer
Miles Yerger, P.E., MDT Pavement Design Engineer